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(54) **Title of the Invention**: Tow Packing Apparatus

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SPECIFICATION

1. Title of the Invention

Tow Packing Apparatus

2. Claims

A tow packing apparatus characterized in comprising:

compression boxes movably provided between a tow receiving position and a tow compressing position;

a receiving plate vertically movably provided in the compression box;

an apparatus for vertically moving the receiving plate in the compression box when tow is received in said compression box;

a compression apparatus provided to a tow compressing position in said compression box that compresses tow within the compression box to form same into a packed configuration; and

a tow supply apparatus provided to an upper part of a tow receiving position in said compression box, for feeding tow into the compression box.

3. Detailed Description of the Invention

(Field of Industrial Utilization)

The present invention relates to an apparatus for packing tow (continuous fiber bundles) in high densities.

When conventionally packed, tow is stored in cartons made of corrugated cardboard or another material. In order to stuff the carton to a slightly higher density when the tow is placed therein, e.g., a hopper is placed above the carton opening, [the contents] are compacted within the strength range of the carton, the hopper is removed, and the carton is covered with a lid.

However, tow cannot be packed densely with such packing methods due to the strength of the carton box and other factors. Consequently, the overall volume increases, which increases transport costs; and greater warehousing space is used, which increases storage costs. If the carton is reinforced to increase its strength, packing material costs will increase. Furthermore, carton volumes have necessarily increased due to the greater weight of packed contents that has accompanied increasing demand over the past several years, and complications have been presented in regard to the handling of the cartons themselves.

With the foregoing aspects in view, it is an object of the present invention to provide a tow packing apparatus that will compress tow in higher densities and increase the density of the packing, while allowing the weight of the packed contents to increase, and the costs of the packing materials to be reduced.

An embodiment of the present invention shall be described hereunder with reference to the accompanying drawing.

The symbol (1) indicates a frame, on which a vertical shaft (2) is supported. On either side of the vertical shaft (2) is a pair of squarely cylindrical compression boxes (3) whose upper and lower surfaces are open, and which are rotatably supported in a horizontal direction with the vertical shaft (2) as the center. Door plates (4) that, when closed, constitute a part of the compression boxes (3), are openably and closably attached to the four peripheral surfaces in the upper parts of the compression boxes (3).

Receiving plates (5) are provided to the compression boxes (3) in a vertically movable manner and so as not to pass downwardly through a bottom end opening of the compression boxes (3). The upper surface of the receiving plate (5) is provided with a plurality of guide grooves (6).

An apparatus (7) for moving the receiving plate upward or downward is provided to a lower region of a tow receiving position (A) located in one of the compression boxes (3). A cylinder apparatus (8) for moving the receiving plate upward or downward, and associated with the apparatus (7), is provided to the frame (1); and a support plate (10) that faces a lower surface of the receiving plate (5) is mounted on an upper end portion of a piston rod (9) upwardly protruding from the cylinder apparatus (8).

A compression apparatus (11) is provided to a lower part of a tow compressing position (B) located in the other compression box (3). A compression cylinder apparatus (12) associated with the compression apparatus (11) is provided to the frame (1), and an urging body (14) that faces a lower surface of the receiving plate (5) is mounted on an upper end of a piston rod (13) upwardly protruding from the compression cylinder apparatus (12). A pressure-receiving body (15) facing an upper end surface of the compression box (3) is provided to an upper part of the tow compression position (B) on the frame (1), and on an upper surface of the pressure-receiving body (15) are formed a plurality of guide grooves (16) corresponding to the guide grooves (6) of the receiving plate (5).

A tow feeding apparatus (21) is disposed on an upper part of the tow receiving position (A). A pair of rails (22) is provided in parallel to the tow supply apparatus (21) on the frame (1). A cart (23) is advanceably and retractably supported on this pair of rails (22) via pivotally installed wheels (24) attached to both sides of the cart (23) by axles. A tow supply chute (25) is rotatably provided to the center portion of the cart (23), whose upper and lower surfaces are open, in an upper region thereof in a direction perpendicular to the direction of movement of the cart (23). A pair of tow guiding rollers (26) is further disposed in an upward position on the cart (23), so that tow (27) will be continuously supplied via this pair of tow guiding rollers (26).

The operation of the invention shall be described hereunder.

First, the pair of compression boxes (3) are respectively set in the tow receiving position (A) and the tow compressing position (B). The cylinder apparatus (8) used for moving the receiving plate upward and downward is upwardly actuated, and the support plate (10) is raised by the associated piston rod (9). The receiving plate (5) of the compression box (3) in the tow receiving position (A) is supported on the support plate (10), and rises in the compression box (3). The receiving plate (5) is stopped at the upper end thereof. The upper surface of the

receiving plate (5) and the lower end opening of the tow supply chute (25) are set so that a prescribed gap; e.g., 1 to 50 cm, will be maintained with the tow supply chute (25) in a perpendicularly suspended state.

The tow supply apparatus (21) is then actuated so that the feed of tow (27) is initiated. The tow guiding rollers (26) will deliver the tow (27) from the tow supply chute (25) into the compression box (3). At this time, the cart (23) of the tow supply apparatus (21) will reciprocatingly advance and retract on the rails (22) at a uniform rate across the width of the compression box (3) opening, and the tow supply chute (25) will be turned in a reciprocal fashion at a uniform or substantially uniform rate, so that there will be a fixed rate at which the tip thereof projects across the width of the other opening of the receiving box (3), in a direction perpendicular to the direction in which the cart (13) advances. Accordingly, the reciprocatory advancing and retracting movement of the cart (23) and the pendulum-like reciprocating rotary movement of the tow supply chute (25) will neatly load the tow (27) in a zigzag fashion on the receiving plate (5) in the compression box (3). The cylinder apparatus (8) for moving the receiving plate upward and downward is downwardly activated at the same time that the tow (27) is being supplied, and the receiving plate (5) will be lowered together with the support plate (10) in synchronization with the rate at which the tow (27) is supplied. At this time, the aforementioned prescribed gap will be maintained between the upper surface of the tow (27) that has been loaded on the receiving plate (5) and the bottom end opening of the tow supply chute (25).

As the receiving plate (5) descends, the tow (27) will be loaded continuously in a zigzag fashion in the compression box (3), and once the receiving plate (5) reaches its lowest position, the supply of tow (27) will be halted, and the tow (27) will be cut at the tip end of the tow supply chute (25), and terminated.

The pair of compression boxes (3) are then rotated 180° around the vertical shaft (2), so that the compression box (3) that had received the tow (27) is moved from the tow receiving position (A) to the tow compressing position (B), and the other compression box (3) is moved from the tow compressing position (B) to the tow receiving position (A). The tow (27) is then loaded in the same manner as described hereinabove in the compression box (3) that has been newly placed in the tow receiving position (A).

Meanwhile, once the compression box (3) containing the tow (27) has been placed in the tow compressing position (B), the compressing cylinder apparatus (12) is upwardly activated, and the urging body (14) is moved upward via the piston rod (13). The receiving plate (5), supported by the urging body (14), is raised in the compression box (3), compressing the tow (27) between the receiving plate (5) and the pressure-receiving plate (15). The door plates (4) are released to yield a block (27_a) of compressed tow (27) in a packed configuration.

Next, a band-applying apparatus (not shown) is used to wind and then firmly tighten a plurality of tightening bands made of steel plates or another material around the periphery of the compressed block (27_a) via the guide grooves (16) formed in the receiving plate (5) and the pressure-receiving plate (15). The periphery of the compressed block (27_a) may be covered from above and below with a packaging material made of Hessian cloth or the like before the bands are applied thereto.

The pressure is then released, whereupon the receiving plate (5) is lowered to the withdrawing position, and the block (27_a) of compressed tow (27) is removed.

The compression boxes (3) may be moved via a turntable, conveyor, cart system, or other appropriate method. The tow (27) in the compression box (3) may be compressed by being urged from the bottom in an upward direction, or from the top in a downward direction.

According to the present invention, tow is received in compression boxes and then greatly compressed, thus allowing the tow to be packed very densely. Greater packing densities can be achieved, and packed articles of greater weight can be accommodated. Cartons are additionally dispensed with, thus reducing the packaging material cost.

Furthermore, when the tow is being received, the receiving plate is lowered within the compression boxes in synchronization with the tow feed rate, which allows the tow fed from the tow supplying apparatus to be loaded in a systematic and orderly manner. The tow can be neatly packed when compressed in such a state, which allows greater packing densities to be realized and the removal of the tow in the subsequent step to be performed in a smooth manner.

4. Brief Description of the Drawings

The drawing shows a cut-away front view of a portion showing an embodiment of the apparatus of the present invention.

(3) Compression boxes

(5) Receiving plates

(7) Apparatus for moving receiving plate upward or downward

(11) Compressing apparatus

(21) Tow supply apparatus

(27) Tow

(A) Tow receiving position

(B) Tow compressing position